

Article

Technological and Institutional Analysis of Information and Library Services in Kashkadarya Region

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Abstract: This article analyzes the current state of information and library services in the Kashkadarya region from a technological and institutional perspective. During the study, the level of implementation of digital technologies in information and library centers, electronic library services, automated information systems, the quality of user service, and institutional mechanisms of management were studied. Also, priority areas for the development of the regional information and library system are proposed based on the experience of the CIS, Europe, and developed foreign countries. The results of the study serve to digitize information and library services, improve institutional management, and expand the population's access to information resources.

Keywords: Information Library, Electronic Library, Digitization, Institutional Development, Library Management, Information System, AKM, Digital Transformation, Kashkadarya, Service Quality.

1. Introduction

The information and library system is an important component of the modern knowledge economy and digital society. In recent years, Uzbekistan has been implementing consistent reforms to modernize library activities, develop electronic information resources, and expand the provision of interactive services to the population. On the basis of regulatory legal acts adopted by our President, special attention was paid to the digitization of information and library centers, the creation of electronic catalogs, the development of a national electronic library, and the improvement of library management.

Information and library centers of the Kashkadarya region are also actively participating in these reforms. However, a comprehensive assessment of the technological infrastructure, the level of use of electronic resources, the introduction of modern information systems and the effectiveness of institutional management in the region remains an urgent scientific issue. The purpose of this study is to assess the level of technological and institutional development of information and library services in the Kashkadarya region and develop scientific and practical proposals for their improvement based on foreign experience. Analysis of relevant literature. Issues of developing information and library services have been widely studied by world scientists in recent years. In particular, many scientific developments have been created on the digitization of libraries, management of electronic information resources, remote service to users and the formation of modern models of institutional management.

Russian scholars Yu.N. Stolyarov, Ya.L. Shrayberg, and AV Sokolov have deeply studied the transformation of libraries into information and communication centers, the effectiveness of electronic catalogs and automated library systems. Their research

substantiates the issues of institutional transformation of library activities and the development of digital infrastructure [1], [2], [3].

Scientists from Belarus and Kazakhstan have developed scientific recommendations on integrating library services with state information policy, creating e-government and national digital library platforms [4], [5].

American researchers David Lankes, Michael Buckland, and Karen Coyle view libraries as a central element of the knowledge ecosystem and emphasize the need to create a new generation of library services based on artificial intelligence, open data, metadata, and semantic technologies [6], [7], [8].

European scholars Lorcan Dempsey, R. David Lankes, Anna Maria Tammaro, and Virginia Wilson have developed conceptual models for digital transformation, user-centered services, and improving institutional governance in academic libraries [9], [10], [11].

International recommendations developed by IFLA experts define effective mechanisms for organizing library services based on digital platforms, expanding open scientific information resources, and providing remote services to users [12].

Although Uzbek scientists have also conducted scientific research on the development of the information and library system, the introduction of electronic libraries, and the formation of national bibliographic resources, a comprehensive analysis of technological and institutional development in the case of the Kashkadarya region has not been sufficiently studied. In this regard, this study aims to fill the existing scientific gap.

2. Materials and Methods

The research used a comprehensive range of modern methods of scientific knowledge. The theoretical analysis method studied the conceptual foundations of the development of information and library services, theories of institutional economics and digital transformation [13]. The comparative analysis method compared the activities of information and library centers of the Kashkadarya region with the experience of libraries in Russia, Belarus, Kazakhstan, Germany, Finland and the USA. Based on the statistical analysis method, the number of libraries, users, volume of electronic resources, Internet usage indicators and service quality indicators were assessed. The institutional analysis studied the management model, regulatory and legal framework, financing mechanisms and inter-organizational cooperation system. The strengths and weaknesses, opportunities and threats of the regional information and library system were identified using SWOT analysis. The methods of scientific abstraction, synthesis, induction and deduction were used to summarize the research results.

3. Results and Discussion

Analysis of the technological and institutional modernity of information and library services in the Kashkadarya region is important from the point of view of ensuring knowledge-based development in the region. This analysis allows to increase the efficiency of using information resources, strengthen the infrastructure of education and science, and redefine the role of libraries in the digital economy. Today, in the context of accelerating digital transformation processes, technological modernity and institutional flexibility of information and library systems are particularly relevant. There are regional differences in the Kashkadarya region, uneven development of digital infrastructure, and differences in human resources, and their identification and assessment require scientifically based analysis.

The results of this analysis are of practical importance for improving the activities of regional information and library institutions, substantiating management decisions and expanding digital services. Based on the analysis, priority areas are identified at the AKB-district-branch level, and the possibility of targeted resource allocation arises. The essence of the analysis of technological and institutional modernity is a comprehensive assessment of the level of provision of information and library services with digital technologies, management structure, regulatory and legal frameworks and service delivery mechanisms. This process covers not only technical indicators, but also institutional stability and management efficiency. The main feature of this analysis is that it is based on a systematic and integrated approach. That is, technological indicators (digital fund, cataloging, AI-search) are studied in conjunction with institutional indicators (management, personnel, security). This allows you to fully reflect the real situation.

Such an analysis is practically necessary to expand the scope of digital services in the region, ensure equal access to information, and support socio-economic development. An analytical approach is especially important to identify and eliminate existing problems at the branch level. As a result of the analysis of technological and institutional modernity, the speed of service provision increases, user satisfaction improves, and the efficiency of resource use increases. Also, remote services develop and territorial restrictions are reduced, which increases social efficiency. Practical efficiency is reflected in the following indicators: the share of digitized funds, the coverage of the electronic catalog, the share of online users, the number of remote applications, the share of open knowledge resources, the level of LMS integration, the user satisfaction index, and the level of information security. These KPIs allow for a realistic assessment at the regional level.

The modern feature of the analysis is that it is based on the principles of digital transformation, data-driven management and user-centeredness. Elements such as artificial intelligence, analytics and platform integration make the analysis modern and promising, unlike traditional evaluation. The modern functions presented in Table 1 reflect the main directions of the process of digital transformation of information and library services. If the possibility of remote and uninterrupted access to funds is created through the digitization and storage of information resources, the electronic cataloging and search function increases the efficiency of service provision by quickly and accurately finding information. Remote information and library services eliminate territorial restrictions and expand the scope of users. Scientific and educational content management strengthens the integral connection with education and science through open scientific resources and LMS integration. Analytical and advisory services provide data-driven management and improve the quality of decisions, while user-tailored services form a modern service model focused on individual needs. The information security and protection function is one of the important modern functions that ensure trust and stability in the digital environment (Table 1).

Table 1. KPI (indicator) system for assessing modern functions in information and library institutions.

No.	Modern function	Unit of measurement	KPI (indicator name)	Assessment content
1	Digitization and preservation of information resources	%	Digitized stock share	Percentage of digitized materials within the total collection
		thousand files / GB	Digital fund size	Quantity of electronic resources

2	Electronic cataloging and searching	%	Electronic catalog coverage	Share of resources included in the electronic catalog
		seconds	Average search time	Speed of finding information
3	Distance information and library services	%	Percentage of online users	Remote users
		piece	Number of remote applications	Online survey and service volume
4	Scientific and educational content management	%	Share of open science resources	The weight of Open Access materials
		score	Level of integration with educational platforms	Connection with LMS and educational systems
5	Analytical and consulting services	piece	Number of analytical services	Volume of analytical and consulting services
		score	Level of decision support	Decisions based on analytics
6	Personalized services	score	Level of personalization	AI recommendations and level of customization
		%	User satisfaction index	Based on questionnaires
7	Information security and protection	score	Information security level	Cybersecurity situation
		piece	Number of data losses	Security breaches

Table 1 fully covers the digital value chain of the “modern information library”: resource digitization → discovery (search) → remote service → content management → analytics/advice → personalization → security. KPIs are also divided into (1) coverage, volume, (2) time, score, and (3) satisfaction, incidents groups.

For digitization and preservation of information resources, Digitized Fund Share (%) is the most basic indicator of the system. If it is high: rapid response to user needs, remote services and the effectiveness of the electronic catalog increase. If it is low: the remaining functions are limited due to the “lack of digital content”. “Digital Fund Size (thousand files/GB)” — it is not enough to just say “increased”; quality metrics are also needed here (format standards, metadata, backup, storage policy). Otherwise, the size will grow, but search and use may be poor. In electronic cataloging and search, the “e-catalog coverage (%)” must be “matched” with the digital fund: if digitized materials are not fully reflected in the catalog, the user will still not be able to find them. “Average search time (seconds)” is an indicator of user experience (UX). As the time decreases, the quality of service

increases. However, this KPI is not only related to “server speed”, but also to the quality of metadata, keywords, classification (UDK/BBK), and search algorithm.

Remote information and library services “Share of online users (%)” — a “market penetration” indicator of digital transformation: are the services actually working, are people accepting them. “Number of remote requests (pcs)” — shows demand and load. It is useful to break this down by service type: (i) reference/request, (ii) electronic delivery, (iii) registration, (iv) consultation. Then it becomes clear which direction is the “growth driver”.

In the management of scientific and educational content, “Share of Open Science Resources (%)” — enhances scientific visibility, citation and academic collaboration (Open Access). If this indicator is high, the library becomes an operator of the scientific ecosystem, not a “just a custodian”. “Degree of integration with educational platforms (score)” — a critical KPI for universities/colleges. If integration is strong: students find content within the LMS, usage increases, search time decreases. If low: the resource is there, but “has not entered the learning process”.

Analytical and consulting services “Number of analytical services (units)” — indicates the expansion of the service portfolio (reports, bibliometric analysis, thematic review, training). “Decision support level (score)” — the most “strategic” KPI: does the analytics result have a real impact on management decisions? Here, rather than simply assigning a score, the assessment will be more reliable if it is reinforced with criteria such as the share of approved decisions, acceleration of the decision cycle, and optimization of resource allocation. User-tailored services “Personalization level (score)” — AI recommendations, personal account, interest profile, push notifications. The higher the score, the higher the retention and depth of use. “User satisfaction index (%)” — the resulting KPI. An important point: satisfaction is not only measured by “liked/disliked”, but also by the questions “Did I find it? Is it fast? Is it understandable?” It will become clear which function has a problem.

Information security and protection “Information security level (score)” is the “foundation” of system stability: authentication, role-based access, backup, log, update, cyber hygiene. “Number of information losses (pcs)” is a real indicator of risk. This KPI should approach zero, but if it is not only “incident”, but also by type of incident (data loss, unauthorized access, phishing, failure), then preventive measures will be selected more accurately. Possibilities of using the table (scientifically).

This KPI indicator system allows for a comprehensive assessment of the modern functions of information and library services in the context of digital transformation. The indicators serve as a quantitative expression of economic and social results and serve as a reliable methodological basis for empirical analysis and integrated assessment models. The block in Table 2 is the most fundamental direction that determines the digital basis of an information and library institution. The indicators of the share of digitized funds and the volume of digital funds reflect the institution's capacity to store information, its continuous use and future analysis. A Low level indicates that a significant part of the fund is still in analog form, while a High level indicates that digital resources have been formed in sufficient volume and there is a balance between the AKM-district-branch levels. Growth in this block is a prerequisite for the development of all other digital services.

Table 2. KPI-based Low–Medium–High scale for assessing the technological maturity of information and library institutions (at the level of the Central Library, district, and branch).

Bloc k	KPI (indicator)	Measuremen t	Directio n	Low	Medium	High
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1.	Digitized stock share	%	↑	< 30	30–60	> 60
2.	Digital fund size (in level section)	GB/thousand files	↑	AKM: <500 / <100 • District: <150 / <30 • Branch: <30 / <6	AKM: 500–2000 / 100–400 • District: 150–600 / 30–120 • Branch: 30–120 / 6–25	AKM: >2000 / >400 • District: >600 / >120 • Branch: >120 / >25
3.	Electronic catalog coverage	%	↑	< 40	40–75	> 75
4.	Average search time	seconds	↓	> 7.0	3.0–7.0	< 3.0
5.	Percentage of online users	%	↑	< 25	25–55	> 55
6.	Number of remote applications (by level, per year)	pcs/year	↑	AKM: <3000 • District: <1000 • Branch: <300	AKM: 3000–12000 • District: 1000–4000 • Branch: 300–1200	AKM: >12000 • District: >4000 • Branch: >1200
7.	Share of open science resources (Open Access)	%	↑	< 15	15–40	> 40
8.	Level of integration with learning platforms (LMS)	score (0–100)	↑	< 40	40–70	> 70
9.	Number of analytical services (by level, per year)	pcs/year	↑	AKM: <30 • District: <10 • Branch: <4	AKM: 30–120 • District: 10–40 • Branch: 4–15	AKM: >120 • District: >40 • Branch: >15
10.	Level of decision support	score (0–100)	↑	< 40	40–70	> 70
11.	Level of personalization (AI recommendations, personal account)	score (0–100)	↑	< 35	35–65	> 65
12.	User satisfaction index	%	↑	< 70	70–85	> 85
13.	Information security level	score (0–100)	↑	< 50	50–80	> 80
14.	Number of data losses (incidents, per year)	pcs/year	↓	> 5	2–5	0–1

The second block of analysis is Electronic Cataloging and Search, where the coverage of the electronic catalog and the average search time directly characterize the efficiency of information use. At a low level, the user loses a lot of time searching for information, which reduces the quality of service. An average level indicates that the system is available, but needs optimization. A high level indicates that cataloging is fully implemented and search processes are fast. This block is a key indicator of user experience (UX) and the quality of digital services.

The third block shows the territorial and temporal expansion of library services, the share of online users of remote information and library services and the number of remote requests. A low level indicates that services are mainly in a traditional form, while a high level indicates that active use has been formed in the digital environment. The differentiation by AKM, district and branch allows us to assess the real load and institutional capacity of these services. This block is important in assessing digital inclusion and the scope of use of services.

The fourth block is the section on scientific and educational content management, the share of open scientific resources and the level of integration with the LMS determine the place of the information library in the scientific and educational ecosystem. At a low level, scientific content is closed or fragmented, while at a high level, the library actively supports the Open Access policy and is inextricably linked to educational platforms. This block plays a strategic role in ensuring the digital knowledge economy, distance learning and academic transparency. The fifth block, analytical and advisory services, the number of services and the level of decision support, characterizes the role of the library as an active knowledge center. If at a low level the library is primarily an information institution, at a high level it becomes a subject that provides analytical reports, data-based advice and supports management decisions. This block reveals the economic and managerial effectiveness of digital transformation.

The sixth block, personalized services, personalization level, and user satisfaction index, shows how well the services are organized based on a human-centered approach. At the Low level, services are not standardized and flexible, while at the High level, there are AI-based recommendations, personal cabinets, and high satisfaction. This block allows you to assess how well the library's digital services meet real needs.

The seventh block analysis shows the level of information security and protection and the number of incidents reflect the stability and reliability of the digital environment. At a low level, security vulnerabilities and frequent losses are observed, while at a high level, cybersecurity policies are effective and incidents are minimal. This block is presented as a basic assurance mechanism that protects all digital functions.

Table 3. Results of assessment of technological maturity of information and library institutions based on KPIs (at the level of AKM-district-branch).

KPI	AKM (value → level)	District (value → level)	Branch (value → level)
Digitized fund share (%)	62 → High	41 → Medium	18 → Low
Digital Stock Size (GB)	2400 → High	420 → Medium	55 → Medium
Electronic catalog coverage (%)	85 → High	60 → Medium	32 → Low
Average search time (seconds)	3.5 → Medium	6.5 → Medium	9.0 → Low
Percentage of online users (%)	58 → High	38 → Medium	18 → Low
Remote applications (number/year)	14500 → High	3200 → Medium	650 → Medium
Share of open science resources (%)	35 → Medium	22 → Medium	8 → Low

LMS integration level (score)	68 → Medium	45 → Medium	25 → Low
Analytical services (units/year)	140 → High	28 → Medium	6 → Medium
Decision support (score)	72 → High	55 → Medium	30 → Low
Personalization (score)	60 → Medium	42 → Medium	20 → Low
User satisfaction (%)	86 → High	80 → Medium	68 → Low
Information Security (score)	84 → High	70 → Medium	52 → Medium
Information losses (units/year)	1 → High		

When we analyze Table 3 by KPIs, the share of digitized funds at the AKM level, which is 62% of the share of digitized funds, indicates that the technological maturity has reached a high level. At the district level, this indicator is at an average level (41%), indicating that the digitization process is actively ongoing. At the branches, the low level remains at 18%, indicating the presence of regional differences and resource shortages.

Digital fund volume The digital fund volume in the Central Library is 2400 GB, which confirms the presence of high technological potential and centralized digital infrastructure. In the districts and branches, an average level is recorded, respectively, which indicates the presence of a vertical imbalance in the volume of digital resources. Electronic catalog coverage, electronic cataloging has reached a high level of 85% in the Central Library, which increases the efficiency of information use. While the average level remains in the districts, the low level in the branches is a factor limiting the ability to quickly access information. The average search time in the Central Library and districts is average, indicating that the system is in place, but needs to be optimized. The fact that the search takes 9 seconds in the branches indicates a low technological level and insufficient cataloging quality. The share of online users The share of online users in the Central Library reaching 58% indicates that digital services are actively used. In the districts, this indicator is average, which indicates the need to strengthen digital literacy and infrastructure. In the branches, the low level remains. The number of remote access is high in the AKM, which indicates the widespread use of library services in the digital environment. In the districts and branches, an average level is observed, which indicates that the potential for using digital services has not yet been fully utilized. Although the AKM and districts are average in terms of the share of open science resources, a low level is observed in the branches [14]. This indicates that equal access to scientific content has not yet been formed and justifies the need to expand the Open Access policy in the regions.

The level of integration with LMS and educational platforms remains moderate in AKM and districts, and low in branches. This indicates that full digital integration between the information library and educational systems is not yet complete.

Analytical services The high level of analytical services in the ALK indicates that the library is becoming an analytical center, not just a repository of information. The average level is maintained in the districts and branches.

Decision support level: Decision-making based on analytics is highly established in the Central Bank. In the districts, this process is in an average state, indicating that the use of data in low-level management decisions in the branches is limited. The level of personalization of services tailored to the user remains at an average level in the Central Bank and districts, and at a low level in the branches. This indicates the need to introduce AI and personal account technologies at the regional level. **User satisfaction:** High user satisfaction in the Central Bank confirms the relatively high quality of the digital services provided. In the districts and especially in the branches, the satisfaction level is lower, and there is a need to improve the quality of services. **Information security** is provided at a high level in the Central Bank, and the number of incidents is minimal. In the districts and

branches, the level of security is average, and institutional and technical measures are required to reduce risks.

This function forms the digital foundation of library activities in digitizing and preserving information resources. The consistent growth of the digitized share of the fund in the Dashboard indicates that information resources are being effectively transferred from analog to digital media. This process creates the necessary conditions for long-term storage, rapid exchange and subsequent analysis of information.

The increase in the coverage and search efficiency of the electronic catalog shows that it provides users with fast and convenient access to information. This function is a key factor that directly increases the efficiency of information use, improves the quality of services and user experience. Remote information and library services stand out as one of the functions with the highest growth rate. The sharp increase in the volume of online requests and remote access shows that library services are becoming free from territorial and time constraints. This function plays an important role in expanding digital inclusion.

The function of managing scientific and educational content is manifested through integration with Open Access resources and educational platforms. The dynamics of KPIs show that the library is becoming a center for knowledge exchange, becoming inextricably linked with scientific and educational systems.

The growth of KPIs for analytical and advisory services indicates that the library is becoming an analytical and advisory institution, not just an information provider. Data-driven analytics is becoming increasingly important in supporting management decisions. The increasing level of personalization of user-oriented services indicates the development of user-oriented services. Personal accounts, recommendation mechanisms, and personalized services increase user satisfaction and increase the intensity of service use.

The information security function is an important factor ensuring the stable operation of digital services [15]. The increased security level and reduced incidents on the dashboard indicate an increase in the reliability of the digital infrastructure. This is of strategic importance for strengthening user trust. This KPI-dashboard clearly demonstrates the balanced and sustainable digital transformation of the information and library system in all modern functions from digitization to analytics and security during 2021–2025.

4. Conclusion and Suggestions

The results of the study showed that in recent years, certain positive changes have been made in the development of information and library services in the Kashkadarya region. In particular, the material and technical base of information and library centers is gradually being strengthened, and the scope of use of electronic catalogs, digital information resources and modern information and communication technologies is expanding. However, the technological and institutional analysis also revealed that there are still untapped opportunities to increase the efficiency of this system.

The analysis showed that the level of development of digital services in some information and library centers is not the same across regions. The existing potential for enriching electronic library collections, providing remote services, introducing mobile applications and information search systems based on artificial intelligence has not been fully utilized. According to the results of the institutional analysis, it is necessary to improve the library management system based on modern management principles, strengthen cooperation with state organizations, higher educational institutions, research centers and the private sector. Also, systematic improvement of digital competencies of library staff and widespread use of innovative management methods can significantly improve the quality of services.

The experience of foreign countries, in particular the USA, Germany, Finland, South Korea and the CIS countries, shows that the modern development of libraries is closely related to digital platforms, electronic resources, open scientific databases, artificial intelligence technologies and user-oriented services. Adapting these experiences to the information and library system of the Kashkadarya region will help improve the quality and efficiency of services.

Thus, technological and institutional modernization of information and library services will not only increase the efficiency of library activities, but also meet the information needs of the population, support science and education, and make a worthy contribution to the digital development of the region.

It is advisable to integrate all information and library centers in the Kashkadarya region into a single digital library platform and ensure the interconnection of electronic catalogs. It is recommended to introduce book recommendations, automatic search, electronic bibliography formation, and virtual librarian services based on artificial intelligence technologies. It is necessary to gradually introduce RFID, QR-code, biometric identification, and automated book issuance and receipt technologies in all information and library centers in the region. It is necessary to integrate electronic library funds with international scientific databases, national digital resources, and open education platforms. It is recommended to organize regular advanced training programs for library staff in digital technologies, artificial intelligence, electronic resource management, and information security. It is advisable to create a single scientific and information cooperation system between higher education institutions, scientific organizations, schools, and information and library centers. To assess the activities of libraries, it is necessary to develop a system of performance indicators, including the level of user satisfaction, the activity of using electronic resources, the share of digital services and innovative activity indicators. It is recommended to organize innovative media centers, coworking areas and digital education laboratories for young people, researchers and entrepreneurs in libraries. It is advisable to widely use public-private partnership mechanisms in financing information and library services, attract grant projects and international cooperation programs. It is recommended to develop a comprehensive strategic development program for the digital transformation of the information and library system of Kashkadarya region until 2030 and identify technological modernization, institutional reforms and human capital development as priority tasks.

The implementation of these proposals will help increase the efficiency of information and library services in the Kashkadarya region, expand the scope of use of modern information and communication technologies, ensure free access to information resources for the population, and develop a knowledge economy and digital society in the region.

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